J. E. MATEER.

TRANSFORMER.

APPLICATION FILED DEC. 18, 1914.

1,249,800.

Patented Dec. 11, 1917.

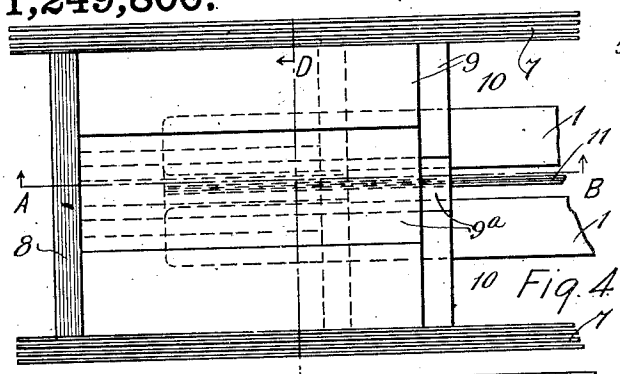


Fig. 4.

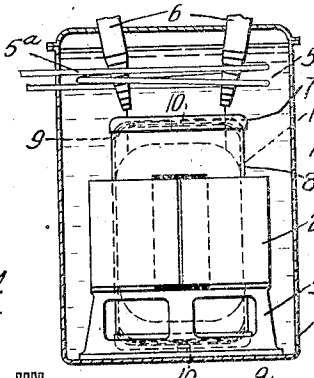


Fig. 1.

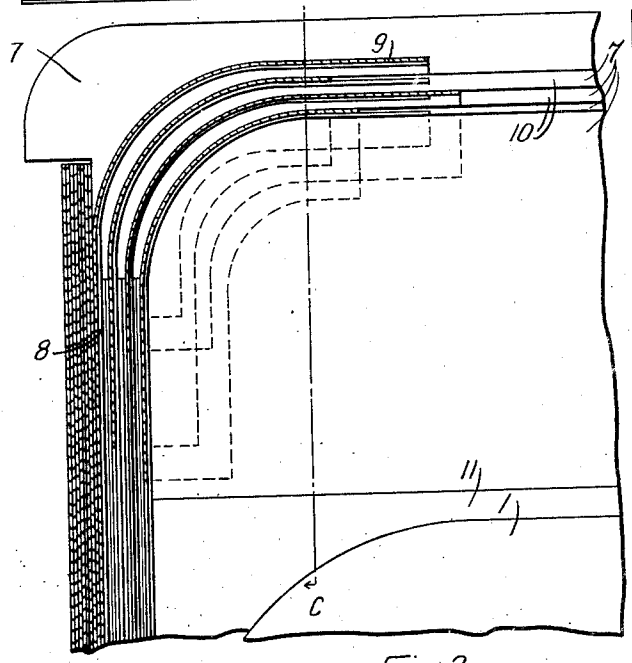


Fig. 2.

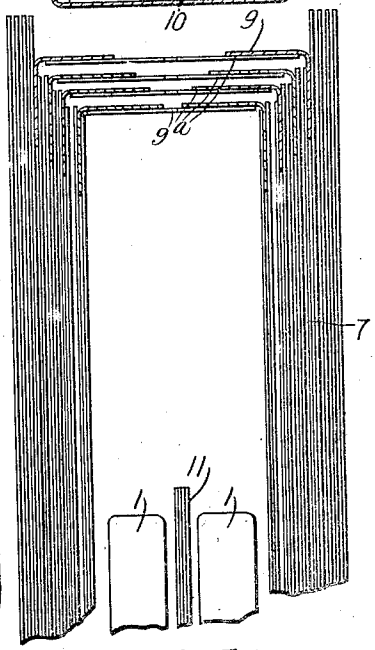


Fig. 3.

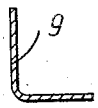


Fig. 6.

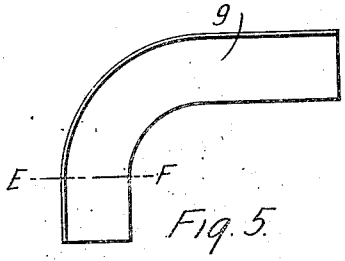


Fig. 5.

WITNESSES:

Fred A. Lind.

Geo. W. Hansen.

INVENTOR

Jesse E. Mateer

BY

Bailey & Baar

ATTORNEY

UNITED STATES PATENT OFFICE.

JESSE E. MATEER, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

TRANSFORMER.

1,249,800. Specification of Letters Patent. Patented Dec. 11, 1917.

Application filed December 18, 1914. Serial No. 877,880.

To all whom it may concern:

Be it known that I, JESSE E. MATEER, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Transformers, of which the following is a specification.

My invention relates to electrical transformers, and it has special reference to means for insulating the high-tension coils thereof from the core members, the end frames, the cooling coils and the inclosing tanks in which the transformers may be disposed.

In transformers adapted for very high-voltage service conditions, such as 100,000 to 150,000 volts, it is highly important to insulate adequately the high-tension coils so as to insure uninterrupted service conditions for the transformers. Because of the difficulty in precluding the flow of leakage currents from the high-tension coils to the conducting low-potential bodies adjacent to the coils, such as the cooling coils, the end frames, the core members and the transformer tanks, without the use of a large amount of expensive insulating material, it has heretofore been necessary to unduly lengthen the tanks in order to substantially increase the leakage distances between the high-tension coils and the conducting low potential bodies adjacent thereto. The use of these large tanks for increasing the leakage distances between the high-tension coils and the cooling coils and the walls of the tanks requires large amounts of insulating and cooling fluids, such as transformer oil, into which the active parts of transformers are usually immersed. Such tanks are also very heavy and cumbersome thereby rendering it difficult to transport them.

By means of my invention, I provide an insulating structure for the high-tension coils of a transformer which will so thoroughly insulate them as to insure reliable and permanent operation of the transformer, and, at the same time, permit the use of a transformer tank the length of which will be considerably less than that heretofore deemed advisable for a like transformer.

For a better understanding of the nature and scope of my invention, reference may be had to the following description and the accompanying drawing in which Figure 1 is a view, somewhat diagrammatic, of an assembled transformer embodying a form of my invention, Figs. 2, 3 and 4 are detail views of the insulating structure interposed between the high-tension coils and the low potential conducting members of the transformer. Figs. 5 and 6 are detail views of the insulating members which I interpose in the leakage current paths from the high-tension coils.

In Fig. 1, current-carrying coils 1, of a usual type of construction, embrace magnetizable core members 2 which are positioned upon an end frame 3 that is placed on the bottom of a tank 4. The tank 4 contains a body of insulating and cooling fluid 5, and is provided with outlet bushings 6 through which the high-tension leads of the transformer extend. The cooling fluid 5 is cooled by means of the cooling coil 5^a through which cold water is usually circulated. The coil 5^a is in relatively close proximity to the upper edges of the high-tension coils 1. The coils 1 are insulated from the core members 2 by means of insulating barriers 7 and 8 which are disposed at right angles to each other. It is essential that the insulating and cooling fluid 5 freely circulate through ducts interposed between adjacent current-carrying coils 1, and, for this reason, it is impossible to entirely inclose the current-carrying coils 1 in an insulating casing. At the same time, the coils 1 must be thoroughly insulated from the core members 2, the end frame 3, the cooling coil 5^a and the tank 4, to preclude the flow of leakage currents. To this end, I have provided a plurality of superposed and spaced insulating members 9 which are bent into L shape and are so interleaved with the insulating barriers 7 and 8 as to substantially increase the length of the leakage paths between the current-carrying coils 1 and the low potential conducting members in proximity thereto. The insulating members 9 do not entirely bridge the open ends of the hollow rectangular structure comprising the insulating barriers 7 and 8, but are separated into two groups at each end thereof to provide openings 10 through which the insulating fluid 5 may circulate.

In Figs. 2, 3 and 4, I have shown, in de-

tail, the insulating structure substantially inclosing the current-carrying coils 1, Fig. 2 being a front view, partially in section, of a portion of the insulating structure, Fig. 3 being a sectional view thereof, taken along the line C—D of Figs. 2 and 4, and Fig. 4 being a top view of a portion of the structure shown in Fig. 3. The high-tension coils 1 are arranged in this instance in groups of two, as shown in Fig. 3, an ordinary insulating barrier 11 being interposed therebetween. A group of insulating barriers 7, arranged in parallel relationship with the barrier 11, are disposed on opposite sides of the coils 1, the insulating barriers 7 comprising a plurality of laminæ made of any suitable insulating material, such as fuller-board. The insulating members 9 are interleaved with the barriers 7 and spaced from, and superposed upon, one another so as to provide a series of overlapping insulating extensions as shown in Figs. 2 and 3. As indicated in Fig. 1, one end of the transformer winding 1 is in close proximity to the adjacent end frame 3. In order to increase the length of the leakage paths between the coils 1 and the end frame 3, the core member 2, and the cooling coil 5^a, I interpose the insulating members 9 which provide a high-resistance leakage path of considerable length between the aforementioned members, as explained above.

As shown in Figs. 5 and 6, the insulating members 9 are formed of angle pieces of material that are bent into L-shape formations. The material from which these pieces is made is relatively thin which permits one side of one leg of these forms to be interleaved with the laminæ 8, and permits the other side to be entirely interleaved with the laminæ 7 that are rounded at their corners to conform with the rounded bends of the L-shaped angle pieces. This method of assembly is clearly shown in Fig. 2 which is a view along the line A—B of Fig. 4. As shown in Fig. 3, adjacent groups of laminæ 7 are thus provided with groups of oppositely and inwardly-extending angle pieces 9. The spaces between adjacent groups of these L-shaped pieces 9 are bridged by insulating laminæ 9^a. In combination with the laminæ 8, the foregoing structure provides an inclosure for the coils 1, but it is important that the groups of insulating members 9, that inclose the opposite sides of the coils 1 in the manner indicated above and shown particularly in Fig. 4, be spaced from each other in order to provide the openings 10 for the circulation of the insulating fluid 5. Moreover, the insulating members 9 are so interleaved with the insulating barriers 7 and 8 as to provide a substantially homogeneous inclosing casing for the coils 1 without affecting the di-electric strength of the barriers 7 and 8. In this way, the current-leakage paths from the coils 1 are lengthened and, moreover, their resistance is greatly enhanced and no impediment is offered to the circulation of the insulating and cooling fluid 5 because the openings 10 provide for the circulation of the oil 5.

By referring to Fig. 2, it will be noted that the superposed members 9, and especially the portions thereof that extend transversely of the plane of the openings 10, are spaced from one another sufficient distances to preclude the leakage currents from the coils 1 from flowing in a straight and direct path to the low-potential members of the transformer, namely, the end frame 3, the cooling coil 5^a and the tank 4. As a consequence, the leakage currents flow along the transverse surfaces of the several spaced and superposed members 9 which are of sufficient extent to greatly increase the length of the leakage paths and, therefore, the resistance to the flow of the leakage currents. In this manner, the same effects are obtained, as concerns the paths for the leakage currents from the coils 1, as by spacing the high-tension coils 1 substantially long distances from all of the low-potential transformer members. In other words, the peripheral walls of the openings 10 are designed to obstruct the direct flow of leakage currents to the low-potential members by making said walls of transversely-extending and spaced insulating laminæ each of which interposes a long high-resistance leakage path to the flow of the leakage currents.

Care must be exercised in the manufacture of the members 9 that the di-electric strength of the material from which they are made is not decreased. To this end, it is important not to fracture the material by using right angle bends opposed to the grain of the insulating material in shaping it to the proper form.

While I have shown and described in detail one embodiment of my invention, it will be apparent to those skilled in the art that many modifications may be made without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a transformer, the combination with current-carrying coils, a magnetizable core member therefor, and laminated insulating barriers interposed between said coils and core member, of a containing tank for the coils and core member, and bent insulating members of L shape interposed in the leakage paths between the coils and the core member and containing tank, one end of the said L-shaped insulating members engaging said insulating barriers and the other end projecting between the said coils and the containing tank.

2. In a transformer, the combination with current-carrying coils and a containing tank

therefor, of superposed and spaced insulating laminæ transversely interposed across the leakage paths between the coils and the tank.

3. In a transformer, the combination with current-carrying coils and a magnetizable core member therefor, of a containing tank for the coils and the core member, said tank being adapted to receive a body of insulating and cooling fluid, and an insulating casing substantially inclosing said coils to insulate them from the core and said containing tank, the insulating casing being provided with top and bottom centrally disposed openings to permit circulation of the cooling fluid, the peripheral walls of which constitute a series of superposed and spaced laminæ to thereby increase the leakage distances between the coils and the containing tank.

4. In a transformer, the combination with current-carrying coils, a magnetizable core member therefor, and insulating laminæ interposed between the coils and the core member, of a containing tank for the coils and the core member, and bent insulating members of L shape which are superposed upon, and spaced from, one another, corresponding ends of said members being interleaved with said insulating laminæ and the other ends being disposed transversely to the leakage paths between the coils and said tank.

5. In a transformer, the combination with current-carrying coils, a magnetizable core member therefor, and insulating barriers between the coils and the core member, of a containing tank for the coils and core members, and superposed and spaced insulating laminæ transversely interposed across the leakage paths between the coils and said core and tank members.

6. In a transformer, the combination with current-carrying coils, a magnetizable core member therefor, and insulating barriers between the coils and the core member, of a containing tank for the coils and core members which is adapted to receive a body of cooling and insulating fluid, and superposed and spaced insulating laminæ interposed in the leakage paths between the coils and said core and tank members, the spaced insulating laminæ being provided with top and bottom openings in order to permit unobstructed circulation of the insulating fluid.

7. In a transformer, the combination with current-carrying coils, a magnetizable core member therefor, of a containing tank for the coils and the core member, said tank being adapted to receive a body of insulating and cooling fluid, an insulating casing substantially inclosing said coils to insulate them from the core, and superposed and spaced insulating laminæ disposed in the path of circulation of the cooling fluid and interposed in the leakage paths between the coils and said core and tank members.

8. In a transformer, the combination with current-carrying coils, a core member and a containing casing therefor, of superposed and spaced insulating laminæ transversely interposed across the leakage paths between the coils and the said core and casing.

In testimony whereof, I have hereunto subscribed my name this 9th day of Dec. 1914.

JESSE E. MATEER.

Witnesses:
M. F. MITSCHUCH,
B. B. HINES.